1. Experimental and numerical study of flame acceleration and transition to detonation in narrow channels

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Abstract

From a scientific point of view, Deflagration to Detonation Transition (DDT) continues to draw significant interest in the research community as an outstanding, physics-rich fundamental problem in combustion science. From a practical perspective, it is important to study and understand DDT in order to develop engineering correlations and simulation tools that can be applied to the prevention and mitigation of explosions. In the current study, flame acceleration and transition to detonation of stoichiometric H2/O2 mixts. in narrow channels was investigated using a combined exptl. and numerical approach. The exptl. setup included direct-, schlieren- and shadowgraph visualization of a 6 mm x 6 mm square channel of 1 m in length. The channel was closed in the region where the mixt. was ignited, and open at the other end. Exptl. x-t diagrams using shadowgraph, revealed that transition to detonation regularly occurred around the first two-thirds of the channel (~ 25 - 55 cm); close-ups to the ignition location using schlieren and shadowgraph visualization showed important details of the ignition kernel. Three-dimensional numerical simulations using quarter symmetry with a simplified chem.-diffusive model are in reasonable agreement with the exptl. results, and shed light into the DDT mechanism in this type of configuration.

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